narda Safety Test Solutions
an L3 Communications Company
http://www.narda-sts.it

NARDA
Safety
Test
Solutions
S.r.l. Socio Unico

**Sales & Support:**
Via Leonardo da Vinci, 21/23
20090 Segrate (MI) - ITALY
Tel.: +39 02 2699871
Fax: +39 02 26998700

**Manufacturing Plant:**
Via Benessea, 29/B
17035 Cisano sul Neva (SV)
Tel.: +39 0182 58641
Fax: +39 0182 586400

# User's Manual

# PMM L1-150M
# PMM L1-150M1

## MULTISTANDARD
## ARTIFICIAL MAINS NETWORKS

- CISPR 16-1-2
- CISPR 25
- ISO 11452-2/4/5
- ISO 7637-2
- MIL-STD-461F
- DO-160
- ED-14G

**SERIAL NUMBER OF THE INSTRUMENT**
You can find the Serial Number on the rear panel of the instrument.
Serial Number is in the form : 0000X00000.
The first four digits and the letter are the Serial Number prefix, the last five digits are the Serial Number suffix. The prefix is the same for identical instruments, it changes only when a configuration change is made to the instrument.
The suffix is different for each instrument.

**Document L1150MEN-31105 – Copyright © NARDA 2013**

**NOTE:**

If the instrument is used in any other way than as described in this Users Manual, it may become unsafe

Before using this product, the related documentation must be read with great care and fully understood to familiarize with all the safety prescriptions.

To ensure the correct use and the maximum safety level, the User shall know all the instructions and recommendations contained in this document.

This products are a **Safety Class I** and **Installation Category II** instrument according to IEC classification and has been designed to meet the requirements of EN61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use).

This product has a **Pollution Degree II** normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

The information contained in this document is subject to change without notice.

**KEY TO THE ELECTRIC AND SAFETY SYMBOLS:**

**You now own a high-quality instrument that will give you many years of reliable service. Nevertheless, even this product will eventually become obsolete. When that time comes, please remember that electronic equipment must be disposed of in accordance with local regulations. This product conforms to the WEEE Directive of the European Union (2002/96/EC) and belongs to Category 9 (Monitoring and Control Instruments). You can return the instrument to us free of charge for proper environment friendly disposal. You can obtain further information from your local Narda Sales Partner or by visiting our website at www.narda-sts.it .**

**Warning, danger of electric shock**

**Read carefully the Operating Manual and its instructions, pay attention to the safety symbols.**

**Earth Protection**

**Earth**

**Unit Earth Connection**

**Equipotential**

**KEY TO THE SYMBOLS USED IN THIS DOCUMENT**

**DANGER** — **The DANGER sign draws attention to a potential risk to a person's safety. All the precautions must be fully understood and applied before proceeding.**

**WARNING** — **The WARNING sign draws attention to a potential risk of damage to the apparatus or loss of data. All the precautions must be fully understood and applied before proceeding.**

**CAUTION** — **The CAUTION sign draws attention against unsafe practices for the apparatus functionality.**

**NOTE:** — **The NOTE draw attention to important information.**

# Contents


| | Page |
|---|---|
| **Safety considerations and instructions.....…….** | V |
| **EC Conformity Certificate…….....** | VI |

| **1 General Information** | **Page** |
|---|---|
| 1.1 Documentation.....…….. | 1-1 |
| 1.2 Introduction to PMM L1-150M and L1-150M1…….. | 1-1 |
| 1.3 CISPR 16-1-2…… | 1-2 |
| 1.4 CISPR 25…… | 1-2 |
| 1.5 ISO 11452-2/4/5…….. | 1-3 |
| 1.6 ISO 7637-2…… | 1-3 |
| 1.7 MIL-STD-461F…… | 1-4 |
| 1.8 DO-160/ED-14G…… | 1-4 |
| 1.9 Shipping components.....…….. | 1-5 |
| 1.10 Environment..... | 1-5 |
| 1.11 Return for service.....…….... | 1-5 |
| 1.12 Equipment cleaning.....…….. | 1-5 |

| **2 Main Specification** | **Page** |
|---|---|
| 2.1 L1-150M Main specifications..... | 2-1 |
| 2.2 L1-150M1 Main specifications..... | 2-2 |

| **3 L1-150M and L1-150M1 Equipment** | **Page** |
|---|---|
| 3.1 L1-150M and L1-150M1 Equipment.....…….....…..... | 3-1 |
| 3.2 Metal lid…… | 3-2 |
| 3.3 Metal base…… | 3-2 |
| 3.4 L1-150M Front and rear panel……..…….. | 3-3 |
| 3.5 L1-150M Safety covers and installation…… | 3-4 |
| 3.6 L1-150M1 Front and rear panel…… | 3-5 |
| 3.7 L1-150M1 Safety covers and installation…….. | 3-6 |

| **4 Installation** | **Page** |
|---|---|
| 4.1 Introduction.....…….....…….... | 4-1 |
| 4.2 Initial inspection.....…….....…….... | 4-1 |
| 4.3 Packing unpacking.....…….....…….... | 4-1 |
| 4.4 Preparation for use.....…….....…….... | 4-1 |
| 4.5 Safety covers installation…… | 4-2 |
| 4.6 Installation check list.....…….....…….... | 4-3 |

| **5 PMM L1-150M and L1-150M1 Application** | **Page** |
|---|---|
| 5.1 Introduction…….....…….... | 5-1 |
| 5.2 CISPR 25…… | 5-1 |
| 5.3 ISO 11452-2/4/5…….. | 5-2 |
| 5.4 ISO 7637-2…….. | 5-3 |
| 5.5 MIL-STD-461F…… | 5-4 |
| 5.6 DO-160/ED-14G…… | 5-4 |
| 5.7 Network verification and maintenance…….. | 5-5 |

# Figures


| Figure | | Page |
|---|---|---|
| 1-1 | Example schematic diagram of artificial network (CISPR 16-1-2)…… | 1-2 |
| 1-2 | Example schematic diagram of artificial network (CISPR 25)…….. | 1-2 |
| 1-3 | Example schematic diagram of artificial network (ISO 11452-2/4/5)…… | 1-3 |
| 1-4 | Example schematic diagram of artificial network (ISO 7637-2)…… | 1-3 |
| 1-5 | Example schematic diagram of artificial network (MIL-STD-461F)……. | 1-4 |
| 1-6 | Example schematic diagram of artificial network (DO-160/ED-14G)…… | 1-4 |
| 3-1 | PMM L1-150M and L1-150M1……..……... | 3-1 |
| 3-2 | Metal lid……... | 3-2 |
| 3-3 | Metal base……... | 3-2 |
| 3-4 | L1-150M Front panel…….. | 3-3 |
| 3-5 | L1-150M Rear panel…….. | 3-3 |
| 3-6 | L1-150M Safety cover on the front panel……..…… | 3-4 |
| 3-7 | L1-150M1 Front panel…… | 3-5 |
| 3-8 | L1-150M1 Rear panel…….. | 3-5 |
| 3-9 | L1-150M1 Safety cover on the front panel……..…… | 3-6 |
| 5-1 | Conducted emissions – EUT with power return line remotely grounded . | 5-1 |
| 5-2 | BCI Configuration – Substitution method……... | 5-2 |
| 5-3 | Slow pulses…… | 5-3 |
| 5-4 | Fast pulses…….. | 5-3 |
| 5-5 | General test setup…….. | 5-4 |
| 5-6 | Conducted RF Interference test setup …… | 5-4 |
| 5-7 | Radiated emissions test setup …… | 5-5 |


# Tables


| Table | | Page |
|---|---|---|
| 2-1 | L1-150M Main Specification……..…….. | 2-1 |
| 2-2 | L1-150M1 Main Specification……..…….. | 2-2 |

## ***SAFETY RECOMMENDATIONS AND INSTRUCTIONS***

This product has been designed, produced and tested in Italy, and it left the factory in conditions fully complying with the current safety standards. To maintain it in safe conditions and ensure correct use, these general instructions must be fully understood and applied before the product is used.

- Over current protection is not provided in the LISN. The LISN must be connected to a power mains which has the properly rated mains protection installed.
- When the device must be connected permanently, first provide effective grounding;
- If the device must be connected to other equipment or accessories, make sure they are all safely grounded;
- In case of devices permanently connected to the power supply, and lacking any fuses or other devices of mains protection, the power line must be equipped with adequate protection commensurate to the consumption of all the devices connected to it;
- In case of connection of the device to the power mains, make sure before connection that the voltage selected on the voltage switch and the fuses are adequate for the voltage of the actual mains;
- Devices in Safety Class I, equipped with connection to the power mains by means of cord and plug, can only be plugged into a socket equipped with a ground wire;
- Any interruption or loosening of the ground wire or of a connecting power cable, inside or outside the device, will cause a potential risk for the safety of the personnel;
- Ground connections must not be interrupted intentionally;
- To prevent the possible danger of electrocution, do not remove any covers, panels or guards installed on the device, and refer only to NARDA Service Centers if maintenance should be necessary;
- To maintain adequate protection from fire hazards, replace fuses only with others of the same type and rating;
- Follow the safety regulations and any additional instructions in this manual to prevent accidents and damages.

## EC Conformity Certificate

**(in accordance with the directives: EMC 89/336/EEC and low voltage 73/23/EEC)**

This is to certify that the product: PMM L1-150M Artificial Mains Network

Produced by: NARDA S.r.l.
Safety Test Solution
Via Benessea 29/B
17035 Cisano sul Neva (SV) - ITALY

complies with the following European Standards
Safety: CEI EN 61010-1 (2001)
EMC : According to art. 1, par. 3 of 2004/108/CE Directive the product herewith is built by passive electric components and does not cause electromagnetic disturbances or its performance is not affected by such disturbances

This product complies with the requirements of Low Voltage Directive 2006/95/CE.

NARDA S.r.l.

## EC Conformity Certificate

**(in accordance with the directives: EMC 89/336/EEC and low voltage 73/23/EEC)**

This is to certify that the product: PMM L1-150M1 Artificial Mains Network

Produced by: NARDA S.r.l.
Safety Test Solution
Via Benessea 29/B
17035 Cisano sul Neva (SV) - ITALY

complies with the following European Standards
Safety: CEI EN 61010-1 (2001)
EMC : According to art. 1, par. 3 of 2004/108/CE Directive the product herewith is built by passive electric components and does not cause electromagnetic disturbances or its performance is not affected by such disturbances

This product complies with the requirements of Low Voltage Directive 2006/95/CE.

NARDA S.r.l.

# 1 - General Information

## 1.1 Documentation

Enclosed with this manual are a service questionnaire to send back to NARDA in case of equipment service is needed, and an accessories check list to verify all accessories enclosed in the packaging.

## 1.2 Introduction to PMM L1-150M and L1-150M1 Artificial Mains Networks

The single-phase V-network PMM's Artificial Mains Networks L1-150M and L1-150M1, with an equivalent circuit of 50 ohm // (1ohm + 5uH), meet the requirements of:
**-CISPR 16-1-2** Radio disturbance and immunity measuring apparatus – Ancillary equipment – Conducted disturbances;
**-CISPR 25** Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices;
**-ISO 11452-2/4/5** Road vehicles – Component test methods for electrical disturbances from narrowband radiated electromagnetic Energy – Bulk current injection;
**-ISO 7637-2** Road vehicles – Electrical disturbances from conduction long supply lines only.
**-MIL-STD-461F** Requirements for the control of electromagnetic interference characteristics of subsystems and equipment.
**-DO-160/ED-14G** Environmental Conditions and Test Procedures for Airborne Equipment.

L1-150M and L1-150M1 are suited to perform measurements of conducted interference in the frequency range from 100 kHz to 200 MHz (L1-150M) and from 10 kHz to 400 MHz (L1-150M1) on both AC or DC power supplied equipment.
Uncompromised design and construction for reliable and safe operation together with PMM 9010 System for Conducted Interference or any other RF receiver.
The main functions performed by the Artificial Mains Network are:

- terminate the DUT with a standardized impedance against reference ground;
- supply power to the DUT;
- insulate the test circuits against external interference coming, for example, from AC-voltage network;
- route the EMI (Electro Magnetic Interference) of the DUT to the receiver, in case of conducted emission measurement, and the EMI from the signal generator to the DUT, in case of susceptibility test (current injection).

### 1.3 CISPR 16-1-2

This part of CISPR 16 is designated a basic standard, which specifies the characteristics and performance of equipment for the measurements of radio disturbance voltages and currents in the frequency range 9 kHz to 108 MHz.

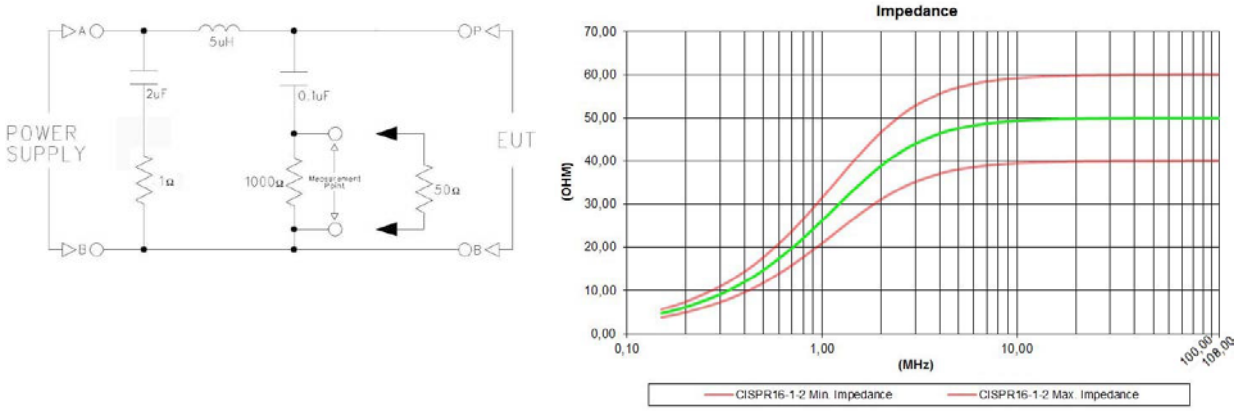



**Fig. 1-1** Example schematic diagram of artificial network (CISPR 16-1-2)

### 1.4 CISPR 25

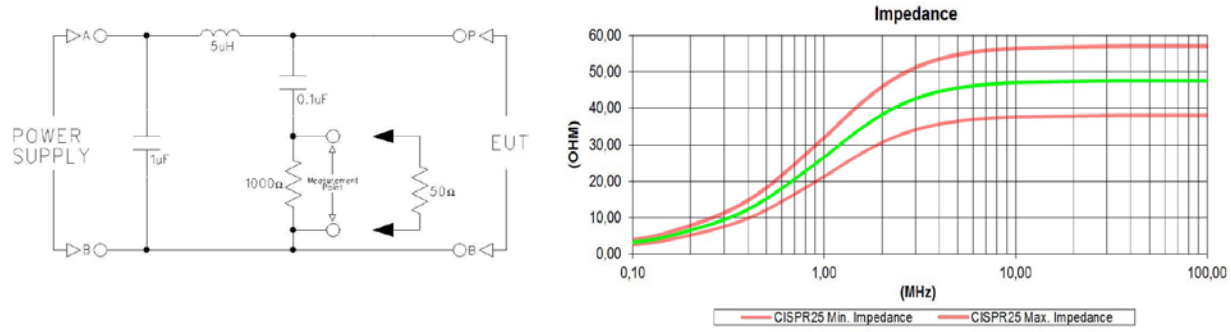



**Fig. 1-2** Example schematic diagram of artificial network (CISPR 25)

### 1.5 ISO 11452-2/4/5

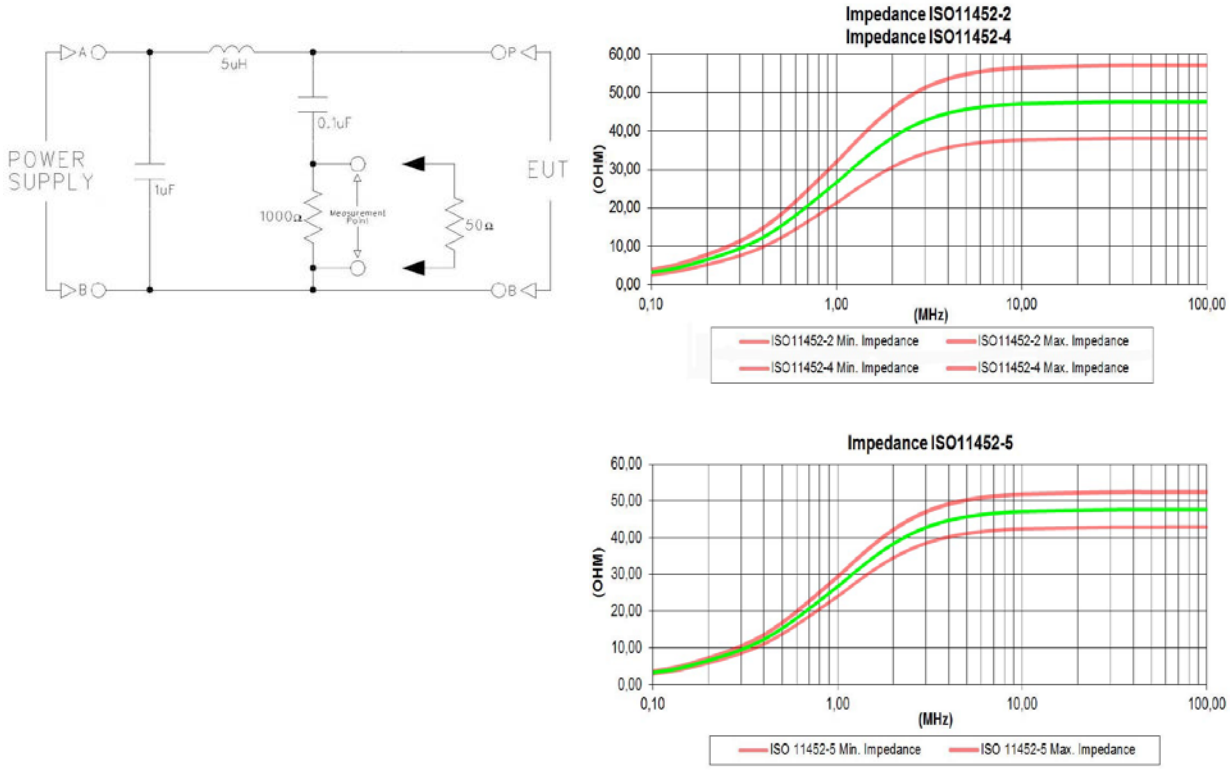



**Fig. 1-3** Example schematic diagram of artificial network (ISO 11452)

### 1.6 ISO 7637-2

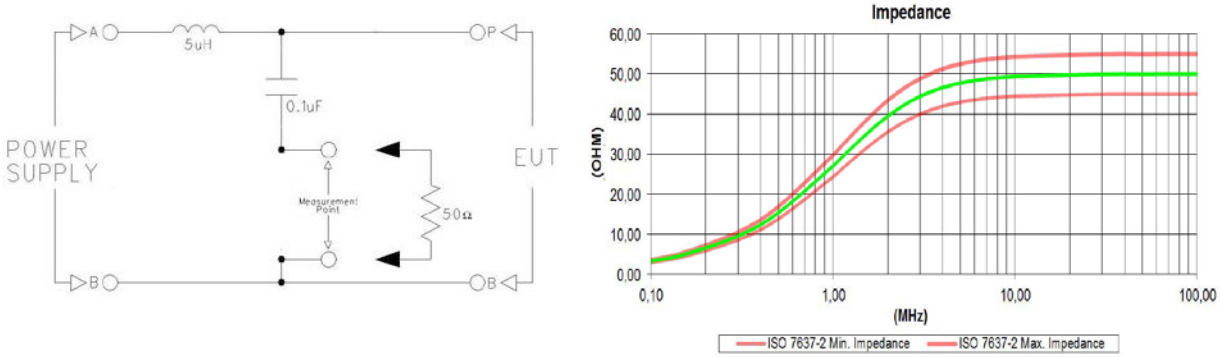



**Fig. 1-4** Example schematic diagram of artificial network (ISO 7637-2)

## 1.7 MIL-STD-461F

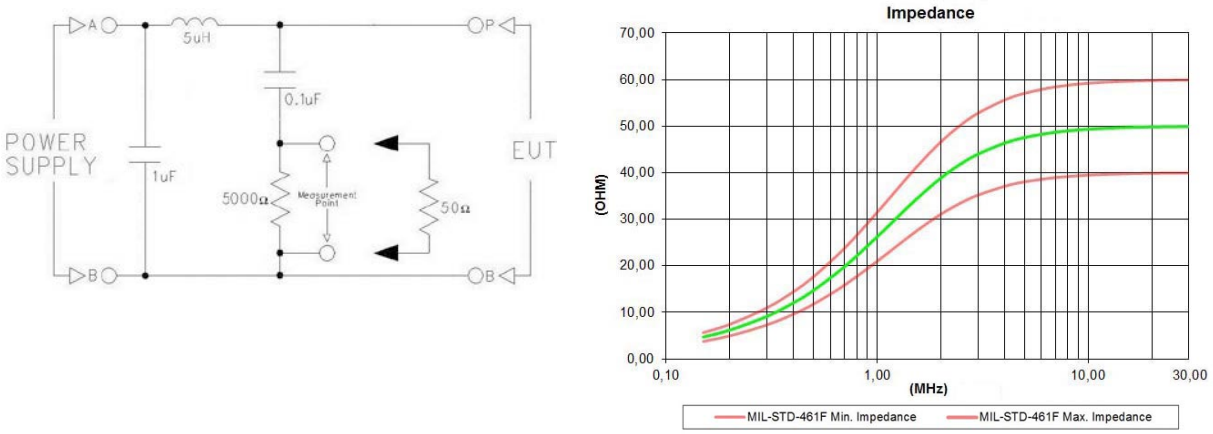



**Fig. 1-5** Example schematic diagram of artificial network (MIL-STD-461F)

## 1.8 DO-160/ED-14G

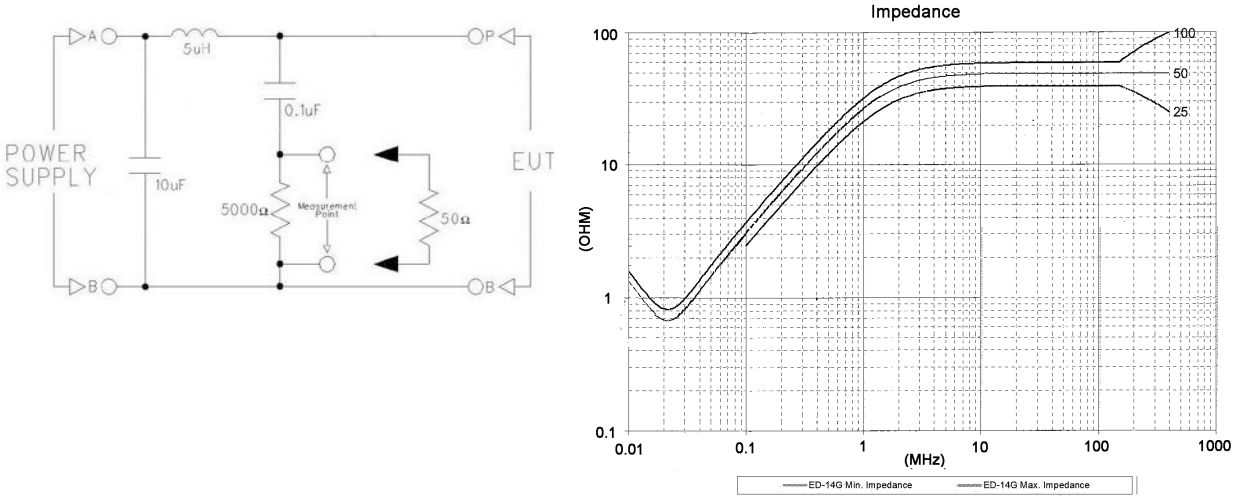



**Fig. 1-6** Example schematic diagram of artificial network (DO-160/ED-14G)

**1.9 Shipping components**

PMM L1-150M and L1-150M1 Artificial Networks are composed by the following parts:

- PMM Artificial Network
- Operating Manual.
- RF Cable
- N-BNC adapter
- Calibration Chart
- Return for repair form

**1.10 Environment**

The operating environment is specified to be within the following limitations:

- Temperature -10° to +45° C
- Humidity < 90% relative

The instrument should be stored in a clean, dry environment
The storage and shipping environment is specified to be within the following limitations:

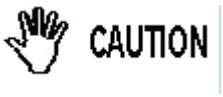
- Temperature -25° to + 70° C
- Humidity < 95% relative

**1.11 Return for service**

If the instrument should be returned to NARDA for service, please complete the service questionnaire enclosed with the Operating Manual and attach it to the instrument.
To minimize the repair time, be as specific as possible when describing the failure. If the failure only occurs under certain conditions, explain how to duplicate the failure.
If possible, reuse of the original packaging to ship the equipment is preferable.
In case other package should be used ensure to wrap the instrument in heavy paper or plastic.
Use a strong shipping container and use enough shock absorbing material around all sides of the equipment to provide a firm cushion and prevent movement in the container.
Seal the shipping container securely with shipment tape.
Mark the shipping container FRAGILE to encourage careful handling.

**1.12 Equipment cleaning**

Use a clean, dry non abrasive cloth for external cleaning of the equipment.




**To clean the equipment do not use any solvent, thinner, turpentine, acid, acetone or similar matter to avoid damage to external plastic and surfaces.**

**This page has been left blank intentionally**

# 2 - Main specifications

## 2.1 L1-150M Main specifications

Table 2-1 lists the PMM L1-150M Network performance specifications.

**TABLE 2-1 Main specifications**

| | |
|---|---|
| **Frequency range:** | 100 kHz to 200 MHz |
| **Continuous rated output current:** | 100 A |
| **Maximum output current (up to $T_a$=45°C):** | 150 A |
| **Max permissible operating voltages:** | 600 VDC<br>300 VAC |
| **AC supply frequency range:** | 0 to 440 Hz |
| **Equivalent circuit:** | (5μH+0/1Ω)//50 Ω |
| **RF output:** | N female |
| **EUT Connector:** | screw terminal M10 |
| **Power supply connector:** | screw terminal M10 |
| **Ground:** | screw terminal M10 (2x) |
| **Rated operating temperature:** | -10 to + 45 °C |
| **Rated Storage temperature** | - 25 to + 70 °C |
| **Overall dimension (W x H x D):** | 230 x 105 x 410 mm |
| **Weight:** | 5 kg |

## 2.2 L1-150M1 Main specifications

Table 2-2 lists the PMM L1-150M1 Network performance specifications.

**TABLE 2-2 Main specifications**

| | |
|---|---|
| **Frequency range:** | 10 kHz to 400 MHz |
| **Continuous rated output current:** | 100 A |
| **Maximum output current (up to $T_a$=45°C):** | 150 A |
| **Max permissible operating voltages:** | 600 VDC<br>300 VAC |
| **AC supply frequency range:** | 0 to 440 Hz |
| **Equivalent circuit:** | (5μH+0/1Ω)//50 Ω |
| **RF output:** | N female |
| **EUT Connector:** | screw terminal M10 |
| **Power supply connector:** | screw terminal M10 |
| **Ground:** | screw terminal M10 (2x) |
| **Rated operating temperature:** | -10 to + 45 °C |
| **Rated Storage temperature** | - 25 to + 70 °C |
| **Overall dimension (W x H x D):** | 230 x 105 x 410 mm |
| **Weight:** | 5 kg |

# 3 – L1-150M and L1-150M1 Equipment

### 3.1 L1-150M and L1-150M1 Equipment

The PMM L1-150M and L1-150M1 are composed by:

- Metal lid;
- Metal base;
- Front panel;
- Rear panel;
- Safety Covers.

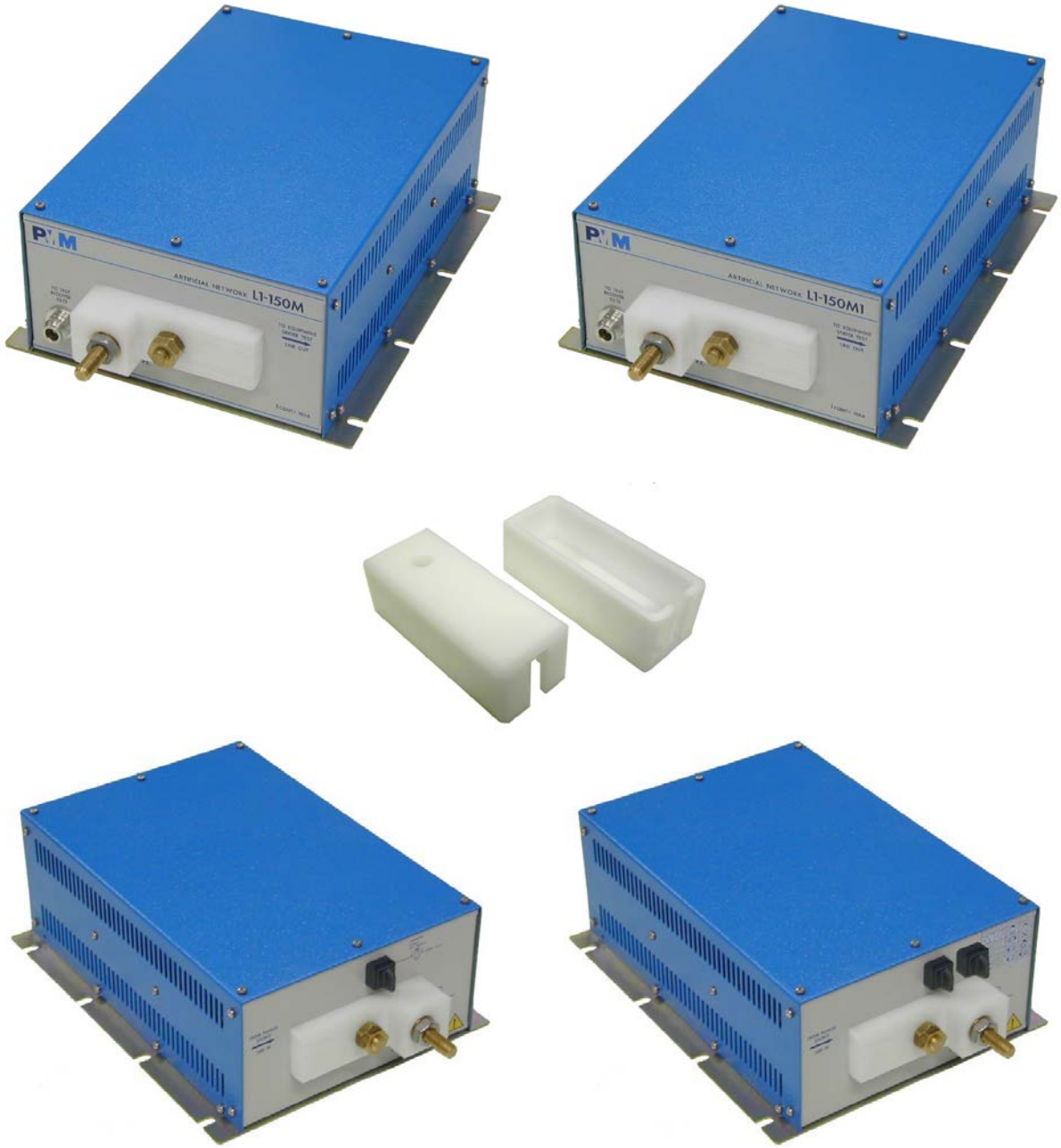



**Fig. 3-1** PMM L1-150M/L1-150M1

### 3.2 Metal lid

The inductor and the other components of the network are mounted on a metal frame which is then closed by metal lid. The lid is perforated in order to improve the heat dissipation.

**Fig. 3-2** Metal lid

### 3.3 Metal base

Hold the L1-150M and L1-150M1 for its metal base to position the Artificial Network where it will be installed, making sure it is leveled to ensure stability; the buttonhole on both side allows to fix the PMM L1-150M and L1-150M1 to the ground.

**Fig. 3-3** Metal base

### 3.4 L1-150M Front and rear panel

L1-150M Front panel.

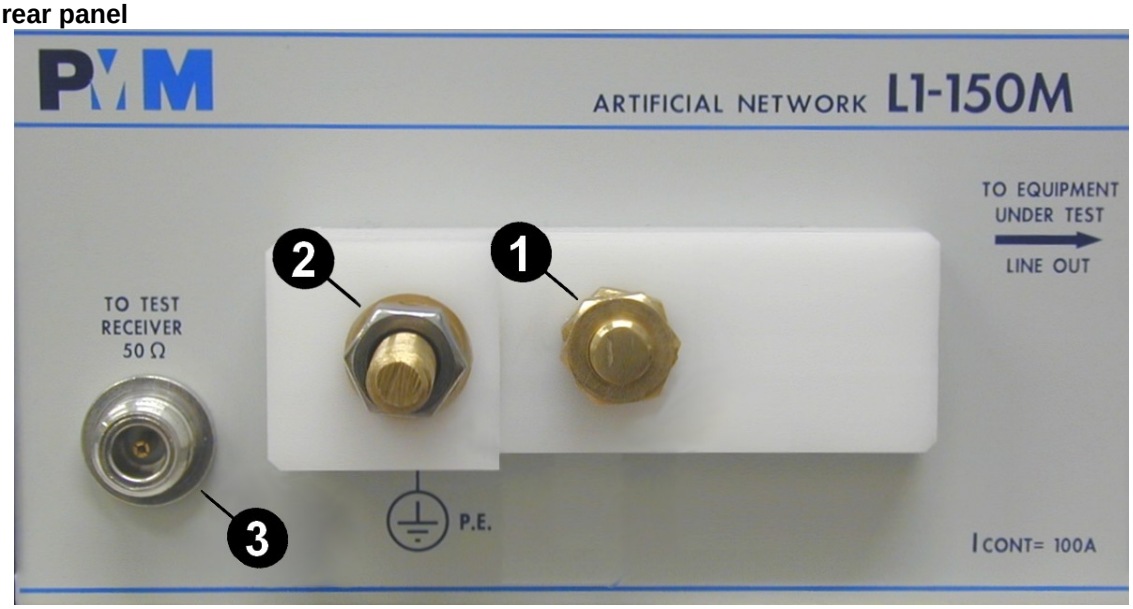



**Fig. 3-4** L1-150M Front Panel

**Legend:**
1- Device Under Test Power Line connecting point
2- Device Under Test Ground contact
3- RF output to EMI Signal Analyzer (50 ohm, N female connector)

L1-150M Rear panel.

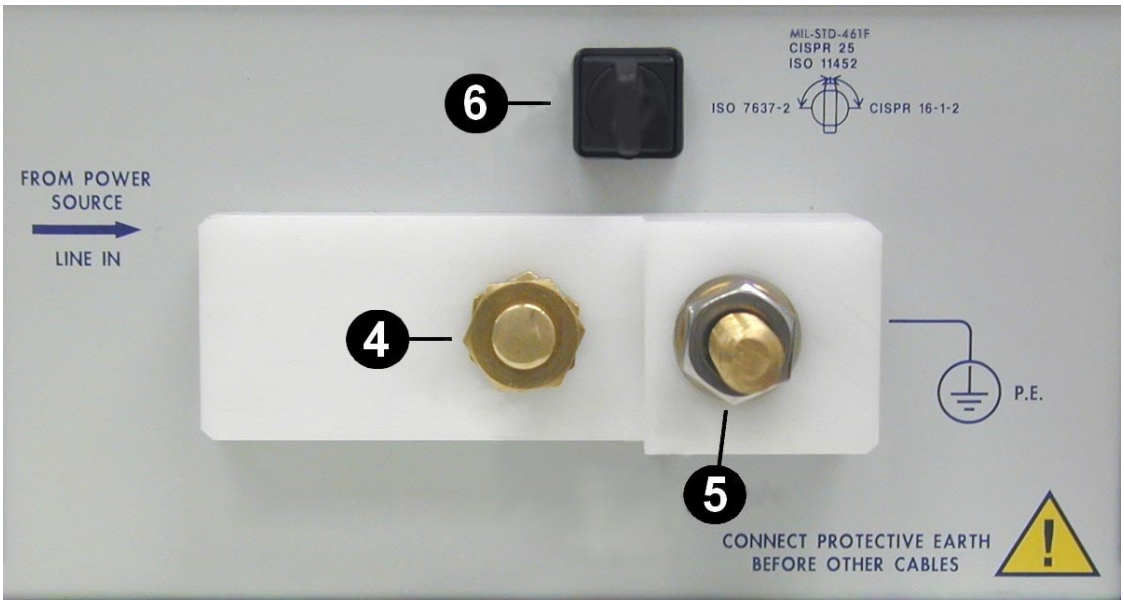



**Fig. 3-5** L1-150M Rear Panel

**Legend:**
4- AC or DC supply connecting point
5- AC or DC ground Protective Earth connecting point
6- Manual switch to select the right standard

### 3.5 L1-150M Safety covers and installation

DANGER

**To avoid hazardous electric shock do not operate PMM L1-150M Network without installing safety covers on active connecting terminals.**

After connection of supply line and Equipment Under Test line, install safety covers on the connecting terminals.

Each cover is nylon made and has a hollow to hold the active cable in place during operation; the active cable shall come out from the cover hollow on the side indicated by an arrow on the front and rear panel.

**Fig. 3-6** L1-150M Safety covers

### 3.6 L1-150M1 Front and rear panel

L1-150M1 Front panel.

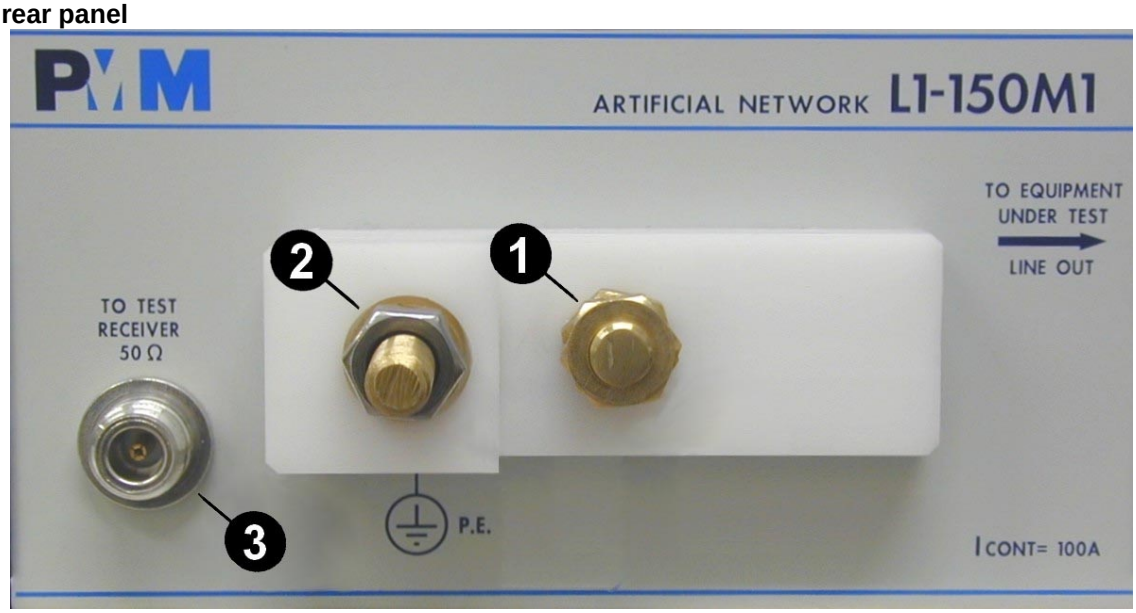



**Fig. 3-7** L1-150M1 Front Panel

**Legend:**
1- Device Under Test Power Line connecting point
2- Device Under Test Ground contact
3- RF output to EMI Signal Analyzer (50 ohm, N female connector)

L1-150M1 Rear panel.

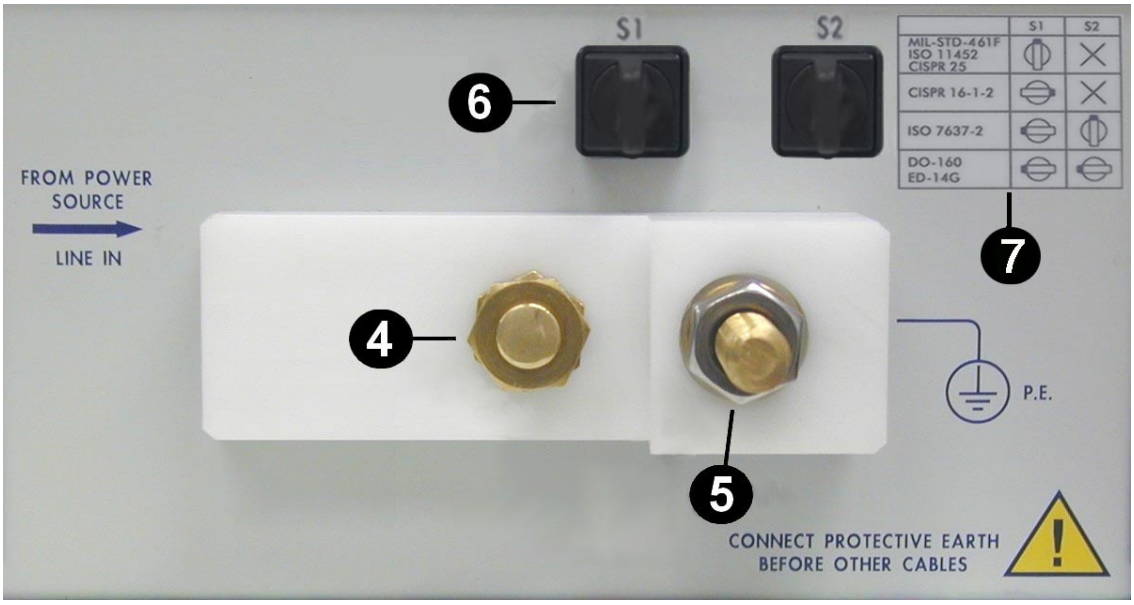



**Fig. 3-8** L1-150M1 Rear Panel

**Legend:**
4- AC or DC supply connecting point
5- AC or DC ground Protective Earth connecting point
6- S1 and S2 manual switch to select the right standard
7- Normative combination chart

## 3.7 L1-150M1 Safety covers and installation

DANGER

**To avoid hazardous electric shock do not operate PMM L1-150M1 Network without installing safety covers on active connecting terminals.**

After connection of supply line and Equipment Under Test line, install safety covers on the connecting terminals.

Each cover is nylon made and has a hollow to hold the active cable in place during operation; the active cable shall come out from the cover hollow on the side indicated by an arrow on the front and rear panel.

**Fig. 3-9** L1-150M1 Safety covers

# 4 - Installation

**4.1 Introduction**

This section provides the information needed to install the PMM L1-150M and L1-150M1 Networks.

**4.2 Initial inspection**

Included is information pertinent to initial inspection, power requirements, interconnections, environment, instrument mounting, cleaning, storage and shipment.

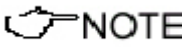
**To avoid hazardous electric shock, do not turn on the instrument if there are signs of shipping damage to any portion of it.**

**4.3 Packing Unpacking**

Inspect the shipping container for damage.
If the shipping container or cushion material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.
Verify the accessories availability in the shipping container referring to the accessories check list enclosed with the Operating Manual.
Notify any damage to the carrier as well as the NARDA Representative.

**4.4 Preparation for use**

From the line conductor to the case of the unit there is a leakage current of appox. 80 mA when operating at 220 V 50 Hz.
The line conductor is connected to ground via a 2 μF capacitor due to the measurement system to be applied.




**The leakage currents between the phase and the earth line generally exceed permitted limits for typical house environments; for this reason the supply distribution in your environment shall not use differential breakers. In case, use an insulating transformer to supply the PMM L1-150M or L1-150M1 Network.**

**To avoid hazardous electric shock, the ground terminals (items 2 and 5 as shown in the panel description) MUST BE connected to the protective earth line before any operation with voltage above 40 V.**

**This is a Safety Class I equipment, it is provided with a protective earth terminal.**
**Before connecting this instrument, ensure that an uninterruptible safety earth ground is provided from the main power source to the product protective earth connection. If this instrument is to be connected to other equipment or accessories, prior to energizing either unit verify that a common ground exists between them.**
**Any interruption or loosening of the protective earth ground conductor, either inside or outside the unit or in an extension cable will cause a potential shock hazard that could result in personal injury. Verify the safety earth ground functionality before operation.**

WARNING

**PMM L1-150M or L1-150M1 Network, the insulating transformer and Equipment Under Test must be overload protected by an appropriate current rating breaker or fuse on the supply line.**

WARNING

**PMM L1-150M or L1-150M1 Network, the insulating transformer and Equipment Under Test must be provided by an appropriate current rated contact breaker.**

CAUTION

**To avoid any damage caused by transient current pulses, disconnect the test Signal Analyzer input before switching AC supply on or off**

The PMM L1-150M or L1-150M1 Network has only one current path from terminal 4 on the rear panel to terminal 1 on the front panel (see Fig. 3-4, 3-5, 3-7 and 3-8 on section 3), the ground terminals 2 and 5 are connected together and to the equipment case, they may be used as a return line only when the Equipment Under Test and its generator use reference ground as a return line. Using AC supply lines isolated from reference ground a separate Network should be used for each line.

DANGER

**The provided front and rear line connection safety covers MUST BE installed before operation.**

### 4.5 Safety covers installation

The following instructions show how to install the safety covers on the front and rear panel:
- If needed unscrew the nut from the terminals.

- Install safety covers on the connecting terminals.

- The power cable shall come out from the cover hollow on the side indicated by an arrow on the front and rear panel

- To fix the cover to the front and rear panel, screw the nut to the terminals.

**4.6 Installation Check list**

Before operation ensure the following steps are taken:

- Check the line voltage to ensure the compatibility with the equipment requirements.
- Ensure that the to be provided fuse or breaker current rating is appropriate for the equipment setup.
- Protective earth line is connected to PMM L1-150M or L1-150M1 input terminal 5.
- Ensure that all cables and terminals in use are suitable on regard of current rating and safety insulation
- Avoid any loose connection and ensure that all network terminals are properly screwed
- Install safety covers on front and rear connections.
- Disconnect the EMI Signal Analyzer input before switching on or off the supply line.
- Prior to energizing either unit verify that a common ground connection exists between all equipment in the test setup and safety protection earth.

CAUTION

**To allow correct equipment ventilation ensure that the vent grids on both sides are free by any obstructing object.**

**This page has been left blank intentionally**

# 5 – PMM L1-150M and L1-150M1 Application

## 5.1 Introduction

Measurement repeatability is the main concern of standards and regulations, that exactly define the test set-up for interference measurements.
In the next paragraphs it will be shown one of the various applications of the L1-150M and L1-150M1 according to the **CISPR-25, ISO 11452-2/4/5, ISO 7637-2, MIL-STD-461F** and **DO-160/ED-14G (**for the L1-150M1 only).

## 5.2 CISPR-25

This International Standard contains limits and procedures for the measurements of radio disturbances in the 150 kHz to 1000 MHz frequency range. The standard applies to any electronic/electrical component intended for use in vehicles and devices. The limits are intended to provide protection for receivers installed in a vehicle from disturbances produced by components/modules in the same vehicle.

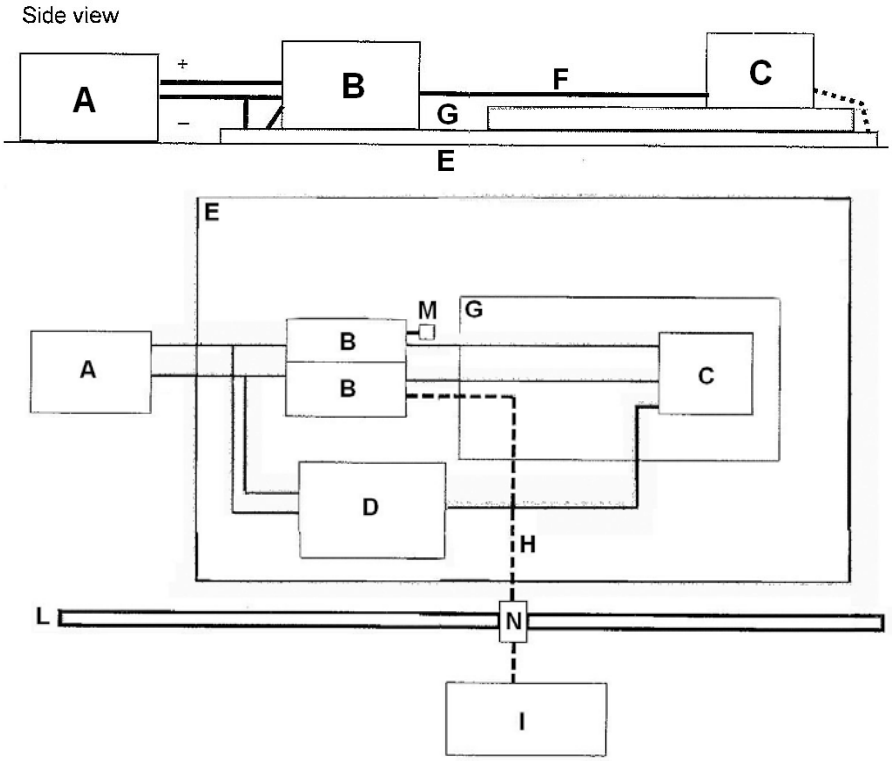



**Fig. 5-1** Conducted emissions – EUT with power return line remotely grounded

The figure describes the test configuration and the interconnection of a mains operated EUT, according to the above mentioned CISPR, where:

A - Power supply
B - Artificial Network
C – EUT
D – Load simulator
E – Ground plane
F – Power supply lines
G – Low relative permittivity support
H – Double shielded or solid shielded coaxial cable (50 Ω)
I – Measuring instrument
L – Shielded enclosure
M – 50 Ω load
N – Bulkhead connector

NOTE

**For further information about PMM L1-150M and L1-150M1 application refer to the normative.**

**5.3 ISO 11452-2/4/5**

This part of ISO 11452 specifies bulk current injection (BCI) test method and procedure for determining the immunity of electronic components of passenger cars and commercial vehicles regardless of the propulsion system.

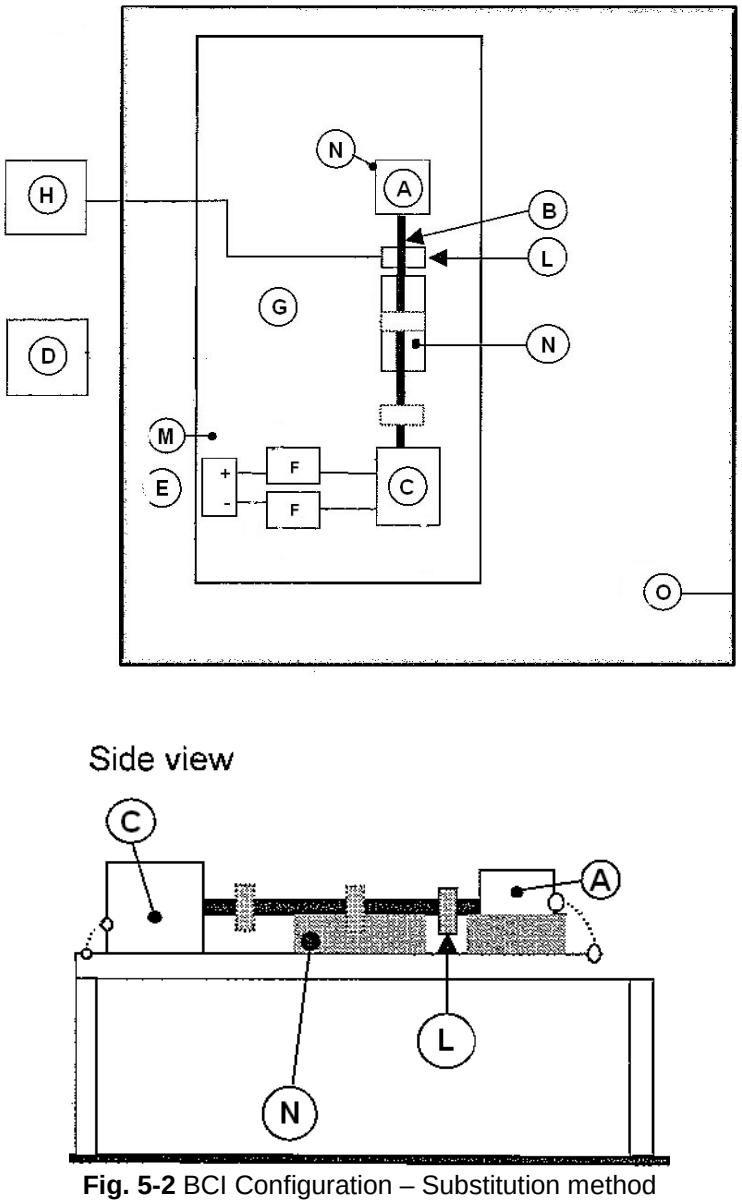



**Fig. 5-2** BCI Configuration – Substitution method

The figure describes the test configuration and the interconnection of a mains operated DUT, according to the above mentioned ISO, where:

A - DUT
B – Wiring harness
C – Load simulator
D – Stimulation and monitoring system
E – Power supply
F – Artificial Network
G – Optical fibers
H – High frequency equipment
I – Optional monitoring probe (not represented)
L – Injection probe (represented at 3 position)
M – Ground plane
N – Low relative permittivity support
O – Shielded room

NOTE

**For further information about PMM L1-150M and L1-150M1 application refer to the normative.**

**5.4 ISO 7637-2**

The part of ISO 7637 specifies bench test for testing the compatibility to conducted electrical transients of equipment installed on passenger cars and light commercial vehicles fitted with a 12V electrical system or commercial vehicles fitted with a 24V electrical system – for both injection and the measurements of transients. Failure mode severity classification for immunity to transients is also given. It is applicable to these types of road vehicle, independent of the propulsion system.

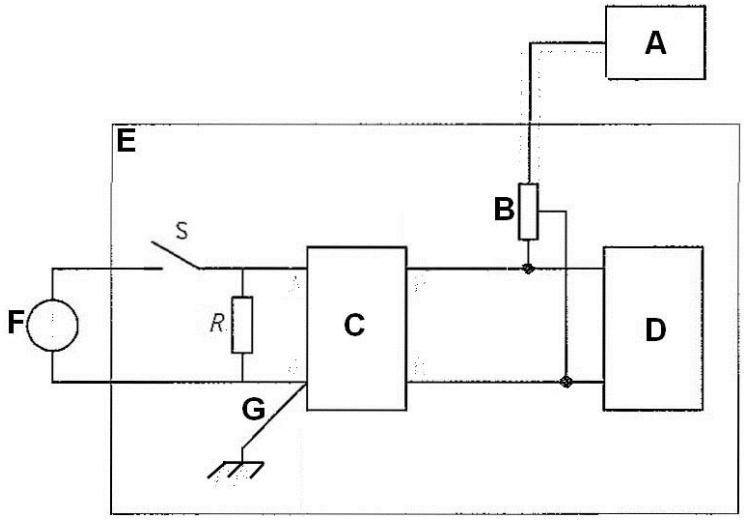



**Fig. 5-3** Slow pulses (millisecond range or slower)

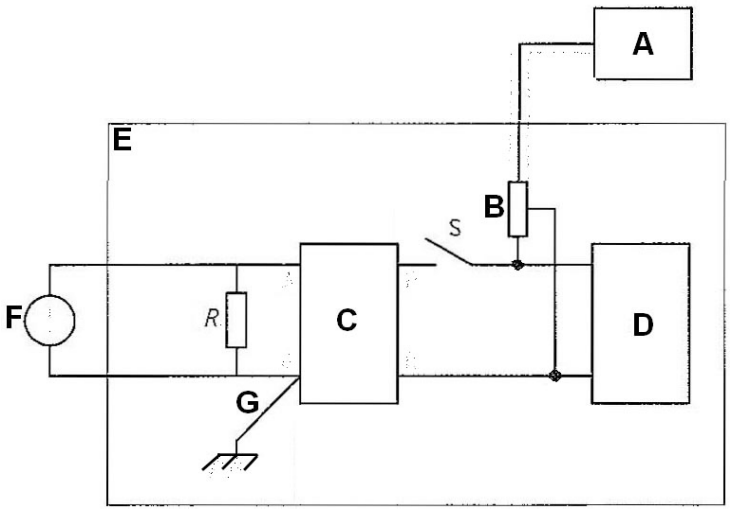



**Fig. 5-4** Fast pulses (nanosecond to microsecond range)

The figure describes the test configuration and the interconnection of a mains operated DUT, according to the above mentioned ISO, where:

A – Oscilloscope or equivalent
B – Voltage probe
C – Artificial network
D – DUT
E – Ground plane
F – Power supply
G – Ground connection

NOTE **For further information about PMM L1-150M and L1-150M1 application refer to the normative.**

## 5.5 MIL-STD-461F

The MIL-STD-461F establishes interface and associated verification requirements for the control of the electromagnetic interference (EMI) emission and susceptibility characteristics of electronic, electrical, and electromechanical equipment and subsystems designed or procured for use by activities and agencies of the Department of Defense (DoD).

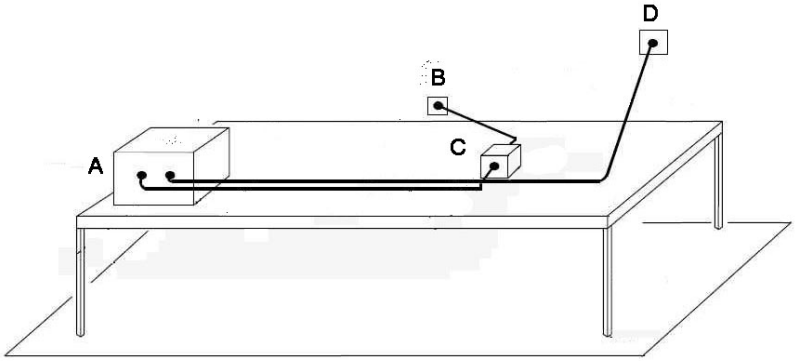



**Fig. 5-5** General test setup

The figure describes the test configuration and the interconnection of a mains operated EUT, according to the above mentioned MIL-STD-461F, where:

A – EUT
B – Power
C – LISN
D – Access panel

NOTE

**For further information about PMM L1-150M and L1-150M1 application refer to the normative.**

## 5.6 DO-160/ED-14G

The DO-160/ED-14G provides standard procedures and environmental test criteria for testing airborne equipment for the entire spectrum of aircraft from light general aviation aircraft and helicopters through the "jumbo jets" and SST categories of aircraft.

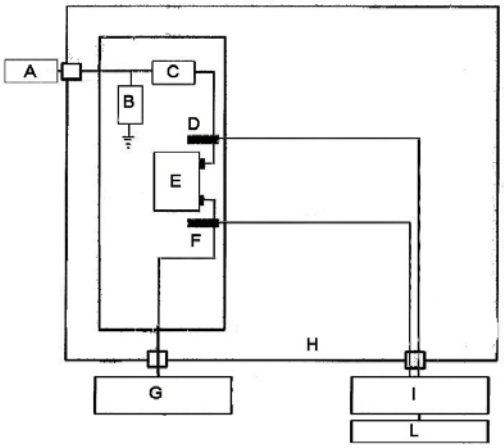



**Fig. 5-6** Conducted RF Interference test

The figure describes the test configuration and the interconnection of a mains operated EUT, according to the above mentioned DO-160/ED-14G, where:

A – Power
B – 10 uF
C – LISN
D – Probe for power line test
E – EUT
F – Probe for bundle test
G – Test Set Interface
H – Shielded Enclosure
I – Spectrum Analyzer
L – Data Recorder

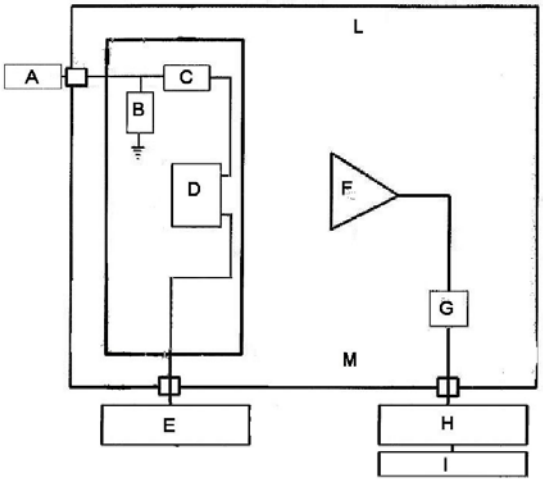



**Fig. 5-7** Radiated emissions test setup

The figure describes the test configuration and the interconnection of a mains operated EUT, according to the above mentioned DO-160/ED-14G, where:

A – Power
B – 10 uF
C – LISN
D – EUT
E – Test set interface
F - Antenna
G – Preamp
H – Spectrum Analyzer
I – Data recorder
L – RF Absorber
M – Shielded Enclosure

NOTE

.**For further information about PMM L1-150M1 application refer to the normative.**

## 5.7 Network verification and maintenance

To verify proper operation of the PMM L1-150M and L1-150M1 Network use the following test procedure:

WARNING

**Do not connect any AC or DC supply to PMM L1-150M or L1-150M1 Network during this verification test.**

Test equipment needed:
1. RF Generator and level measuring calibrated instrument or
2. Spectrum Analyzer with Tracking Generator.

In both cases, instrument shall be working at 1 MHz.

Verification test procedure:
1. Connect the RF signal (or tracking signal) to the mains output of L1-150M or L1-150M1 making sure that the ground is connected to the shield of the RF cable (grounded).
2. Connect PMM L1-150M or L1-150M1 Network RF output 3 to the level-meter input (or Spectrum Analyzer input).
3. Attenuation between generated signal level and measured level on output shall be less than 0.5dB at 1 MHz. If higher than 0.5 dB, please refer to qualified NARDA Service Center for maintenance of the unit.

**This page has been left blank intentionally**

narda Safety Test Solutions
an L3 Communications Company
http://www.narda-sts.it

NARDA Safety Test Solutions S.r.l. Socio Unico

**Sales & Support:**
Via Leonardo da Vinci, 21/23
20090 Segrate (MI) - ITALY
Tel.: +39 02 2699871
Fax: +39 02 26998700

**Manufacturing Plant:**
Via Benessea, 29/B
17035 Cisano sul Neva (SV)
Tel.: +39 0182 58641
Fax: +39 0182 586400

**Mod. 18-1**

Caro cliente
grazie per aver acquistato un prodotto NARDA! Sei in possesso di uno strumento che per molti anni ti garantirà un'alta qualità di servizio. NARDA riconosce l'importanza del Cliente come ragione di esistenza; ciascun commento e suggerimento, sottoposto all'attenzione della nostra organizzazione, è tenuto in grande considerazione. La nostra qualità è alla ricerca del miglioramento continuo. Se uno dei Suoi strumenti NARDA necessita di riparazione o calibrazione, può aiutarci a servirla più efficacemente compilando questa scheda e accludendola all'apparecchio.
Tuttavia, anche questo prodotto diventerà obsoleto. In questo caso, ti ricordiamo che lo smaltimento dell'apparecchiatura deve essere fatto in conformità con i regolamenti locali. Questo prodotto è conforme alle direttive WEEE dell'Unione Europea (2002/96/EC) ed appartiene alla categoria 9 (strumenti di controllo). Lo smaltimento, in un ambiente adeguato, può avvenire anche attraverso la restituzione del prodotto alla NARDA senza sostenere alcuna spesa. Può ottenere ulteriori informazioni contattando i venditori NARDA o visitando il nostro sito Web www.narda-sts.it.

Dear Customer
thank you for purchasing a NARDA product! You now own a high-quality instrument that will give you many years of reliable service. NARDA recognizes the importance of the Customer as reason of existence; in this view, any comment and suggestion you would like to submit to the attention of our service organization is kept in great consideration. Moreover, we are continuously improving our quality, but we know this is a never ending process. We would be glad if our present efforts are pleasing you. Should one of your pieces of NARDA equipment need servicing you can help us serve you more effectively filling out this card and enclosing it with the product.
Nevertheless, even this product will eventually become obsolete. When that time comes, please remember that electronic equipment must be disposed of in accordance with local regulations. This product conforms to the WEEE Directive of the European Union
(2002/96/EC) and belongs to Category 9 (Monitoring and Control Instruments). You can return the instrument to us free of charge for proper environment friendly disposal. You can obtain further information from your local NARDA Sales Partner or by visiting our website at www.narda-sts.it.

☑ **Servizio richiesto:** ☑ *Service needed*:

☐ Solo taratura ☐ Riparazione ☐ Riparazione & Taratura ☐ Taratura SIT ☐ Altro:
☐ Calibration only ☐ Repair ☐ Repair & Calibration ☐ Certified Calibration ☐ Other:

**Ditta:**
*Company:*

**Indirizzo:**
*Address:*

**Persona da contattare:** *Technical contact person:* **Telefono:** *Phone n.*

**Modello:** *Equipment model:* **Numero di serie:** *Serial n.*

☑ ***Accessori ritornati con l'apparecchiatura:*** ☐ **Nessuno** ☐ **Cavo(i)** ☐ **Cavo di alimentazione** **Altro:**
☑ *Accessories returned with unit:* ☐ None ☐ Cable(s) ☐ Power cable Other:

☑ ***Sintomi o problemi osservati:*** ☑ *Observed symptoms / problems*:

☑ ***Guasto*:** ☐ **Fisso** ☐ **Intermittente** ***Sensibile a*:** ☐ **Freddo** ☐ **Caldo** ☐ **Vibrazioni** ☐ **Altro**
☑ *Failure*: ☐ Continuous ☐ Intermittent *Sensitive to*: ☐ Cold ☐ Heat ☐ Vibration ☐ Other

***Descrizione del guasto/condizioni di funzionamento:***
*Failure symptoms/special control settings description:*

***Se l'unità è parte di un sistema descriverne la configurazione:***
*If unit is part of system please list other interconnected equipment and system set up:*

***Suggerimenti / Commenti / Note:***
*Suggestions / Comments / Note:*